DOCUMENT RESUME

ED 319 367 IR 014 384

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TITLE What Today's Educational Technology Needs: Defensible Evaluations and Realistic Implementation.
PUB DATE 88
NOTE 13p.
PUB TYPE Information Analyses (070) -- Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Administration; Classroom Environment; *Computer Assisted Instruction; *Computer Graphics; Educational Facilities Planning; *Educational Technology; Elementary Secondary Education; *Faculty Development; Instructional Development; *Program Evaluation; Program Implementation; *Technology Transfer

ABSTRACT

It is argued that in order to make computer assisted instruction effective in the schools, educators should pay more attention to implementation issues (including modifying teacher attitudes, changing classroom routines, and offering realistic technical training and support) and to producing understandable product and performance evaluations. Issues identified for further evaluation are covariates such as teachers' and students' prior computer experience; the ergonomic design of computerized classrooms; design issues resulting from the pictorial representation of information; and the impact of educational technology integration on classroom social environments. (25 references) (GL)

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# What Today's Educational Technology Needs: Defensible Evaluations and Realistic Implementation

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"There's a great deal of hype involved in all this, a lot of alarm and people jumping up and down," says Edward E. Davis, Jr., president of Exxon Research and Engineering Co . . . (Flaste, 1988, p. 52).

Davis's one-line editorial underscores too much educational experience with computer technology. Commercial marketers paint electronic learning miracles, and teachers dream.

Counterbalancing unbridled technetronic enthusiasm are academic critics. Electronic classrooms, for the most negative, will be caste atop educational technology's growing junk-heap. Information-empowering (Zuboff, 1988) electronic instruction will follow to footnoted extinction teaching machines and other oversold snake-oil.

Overly cautious and reflective and judgmental academicians are, like the American inventor, Charles Kettering's, "slide rule boys" . . .

> . . . who . . . would whip out their slide rules, make two calculations and . . . decide something was impossible. Calculations were based on theory, which, Kettering held, was merely the summary of experience, not the limit of possibility. (Bernstein, 1988, p. 126)



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## Promise and Potential

In computerized educational technology, marketing outraces data-justified applications. While fifth generation computers (Flaste, 1988, p. 45) portend artificial intelligence, American teachers operate in the late Nineteenth Century: most classrooms amount to lighted boxes with doors and windows. Lacing classroom space with high-tech circuitry amounts to wiring up a rusty John Deere tractor with fiber optic cable instead of bailing wire. Although the tractor chugs along, we fail to search for more creative ways to till, plant, and harvest.

Everyday instruction, like a century ago, is predominantly drill and practice. Emerging CAI is networking, database management, interactive distance education, multimedia instructional production, and much more. The distance between technical promise and educational practice remains substantial.

The most fertile fields for applied educational technology lie fallow between theory and action, between consumer cautiousness and sales hype, and between today's educational practice and tomorrow's technical promise. Neither technologists nor educators nor corporate marketers have cultivated the middle ground.

Educators need to be as intent on modifying teacher attitudes, on changing classroom routines, on offering realistic technical training and support (e.g., implementation), and on producing understandable product/performance evaluations as

others are about defining technical specifications or making sales.

This paper will nourish two seedings struggling in the fallow middle ground: (1) defensible CAI evaluations and (2) realistic implementation strategies.

## Defensible Evaluations

American educational practice is graduating. No longer are educators envisioning rooms full of stand-alone PCs and students working through drill-and-practice software. Educators entertain grander visions of computerized information technology comprehensively integrated into a school's curriculum. Drill-and-practice will be supplanted with problem solving simulations and aids like databases, spread sheets, and word processors.

Evaluation strategies lagged behind technical applications. To quote Bozeman and House (1988), even in the early CAI days, " . . . the evaluation processes and paradigms used to asses effectiveness have not always been appropriate. (p. 82) . . . findings are inconclusive and often contradictory" (p. 83). However, evidence for CAI instructional efficacy (Becker, 1987; Burns & Bozemen, 1981; Edwards, 1975; Kulik, Bangert, & Williams, 1983; Suppes, 1966; Thomas, 1979) is widespread, especially in foreign language and science instruction (Patterson & Smith, 1986, p. 83).

Put simply, many (e.g., Bozeman & House, 1988) believe that existing evaluations of CAI efficacy are deficient. In their

eagerness to casually link CAI to key educational indicators, evaluators ignore variables known to mediate school performance.

For example, "life" in American classrooms (Jackson, 1968; 1986) affects student performance. A teacher, if provided detailed descriptions of subtle classroom contextual factors, will be better able to control and predict student behavior. Adding computerized information technology does not simplify the educational puzzle; it adds new pieces.

Educational researchers, too often caricatured as Kettering's "slide rule boys," rarely charm teacher-practitioners (Chien, Cook, & Harding, 1948; Corey, 1949; Farley, 1982; Tikunoff, et al., 1979). Researchers are indecisively abstract; teachers are deliberate and action-oriented. Educational researchers, according to one demeaning stereotype, are frustratingly indecisive; teachers want "what works," action instead of ideas, and results. An unsatiable thirst for tangible results among marketers and technologists is reminiscent of teachers and not educational researchers.

Too often, technologists and teachers choose not to invite educational researchers to project evaluations. Consequently, emerging CAI is plagued with unaddressed basic empirical questions--the primary domain for educational researchers.

1. Why are not covariates, like a student's or the teacher's prior computer experience, more often factored into performance?

2. What about the ergonomic design of computerized classrooms? Assembling effective electronic classrooms may require far more than plopping computers here and there on table tops and stringing miles of wire between the workplaces. The spaghetti-approach may electrify hardware but may do little to maximize learning.

3. "Some of the most fruitful applications of computer technology derive from its capacity to present educationally powerful, dynamic visual images ("Making sense," 1988, p. 10). We are capable of instructionally sequencing colorful and elaborate displays of photos, visuals, and graphs. Information is dense, and students may be learning much that is not intended. Gagne (1986, p. 10) asks, " . . . how can we describe and measure the contents of pictures in a way that is at least comparable to the procedures used to describe prose passages?" How can incidental learning be categorized? What types of outcomes can be learned most efficiently pictorially? (Gagne, 1986) "How can the [computerized] presentation of text be designed to aid learning and retention?" (Gagne, 1986, p. 12). Furthermore, Gagne (1986) reminds us, computers effectively enhance textual displays. Therefore, educators need to investigate the effects of text insertions like pictures or italicized type.

There is much to be learned about the wholesale integration

of educational technology into the classroom's complex social environment.

To expect that a spike in a standardized educational measure is simply linked to CAI experience is naive; school performance is mediated by numerous variables. Nonetheless, simplistic evaluations--and expectations--persist.

As Baker (1988, p. 13) noted, " . . . the indicator movement must be cautious about identifying a single magic index or number to stand for complex educational processes." Educational puzzles, by their very nature, are multivariate. Better electronic classroom designs depend, in part, upon disentangling what computers contribute to learning from teacher contributions (Green, 1984).

"Not enough is known," Bozeman and House (1988, p. 85) concluded, "about how local conditions contribute to the specific nature of CBI projects."

"Investigating impact on student learning [of CAI] is a subtle matter . . . " ("Making sense," 1988, p. 19). The goal is laudable, nonetheless.

Footnote.--Enhanced CAI evaluations portend promise and threat. Evaluation is a weapon for education's anti-technologists; demanding "air tight" conclusive evidence of CAI's efficacy is more than educators and psychometricians can deliver for most areas of education (Baker, 1988). Nonetheless, CAI has received special focus: "[other] Classroom based instruction

. . . receives no similar scrutiny" (Crawford & Crawford, 1983, p. 2).

## Realistic Implementation

Existing evidence suggests that complicated computer configurations will affect student achievement. However, enhanced performance can be due to far more than the computerization. Successfully navigating through the sea of non-computer variables are part of Bozeman and House's "implementation process"--training teachers, re-defining staff responsibilities, rewriting instructional goals and class routines, marshalling organizational support, physically redesigning classrooms, and securing instructional production time. In short, CAI integration amounts to inordinate investments of time and preparation,

As Robert M. Gagne (Interview, 1982), commented: "For the teacher, the problem becomes one of how to incorporate these [computerized] activities into the daily routine of the classroom."

Time, especially during instructional production, may be a pervasive catalyst of success (Mathinos and Woodward, 1987):

> Data from the teacher interviews suggested time as the salient issue for them: time for student use, time for software evaluation and curriculum planning, and time for teacher-development activities. . . . [without time] teachers were "overwhelmed, uninspired, and frustrated."

(Bozeman & House, p. 84)

## Summary

Technically permitting Apples to "talk" to IBMs through AT & T switches or selecting software packages are important components of implementing CAI. The CAI puzzle has many other pieces.

Educational implementation also involves ergonomic and technical design, applied and basic research, defensible evaluations, and the management of teachers and organizational resources (cf. Zuboff, 1988).

Crawford and Crawford (1983; also see Wall, 1986) observed:

> The complexities and problems of shifting from our current creakingly [sic] archaic educational system to a new model that uses the advances in electronic and process technologies to assist us in our 'educational work' are enormous. Further, they impinge upon a variety of social, cultural, and value systems issues as well. Most of the current projects and activities are characterized by long start up periods in which vested interests, threatened managers and naive staff have to be pacified, mollified, and carefully assisted in the acquisition of relevant skills. (p. 7)
>
> . . . we do <u>not</u> see continuing <u>incremental</u> applications of computer-based education in traditional classroom contexts as either adequate or desirable. . . . We are suggesting

> that a research and development paradigm shift is required enabling all of the elements to be addressed in a holistic manner . . . . These are essentially policy and human issues--perhaps the weakest link of all and the least amenable to a 'technological' fix. (p. 59)

In short, successful CAI implementation depends upon educational attitudes, planning, and implementation effort: "External necessity injected into the easy going educational world the urgency that should always be there" (Bloom, 1987, pp. 49-50).

While sales and marketing personnel, technicians, and even students are excited about CAI applications, too many educators, we found, are not urgently marshalling all the resources necessary for seeding fallow ground with representative CAI evaluations and implementations.

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